

wherein said laser beam has an irradiation area of said pulsed laser beam of 10 cm² or more.

21. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

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forming a semiconductor film on an insulating surface;
providing said semiconductor film with a crystallization promoting material comprising a metal;
crystallizing said semiconductor film by irradiating said semiconductor film with a pulsed laser beam having a square shape cross section,
wherein said laser beam has a pulse width of 200 nsec or more, and an irradiation area of said pulsed laser beam is 10 cm² or more.

REMARKS

At the outset, the Examiner is thanked for the thorough review and consideration of the present application.

The Examiner's Office Action dated March 28, 2001, has been received and its contents reviewed. Claims 1-3, 6-13, and 20-23 were pending in the present application. By this amendment, claims 2, 3, 9, 10, 20, and 21 have been amended, and claim 1 has been canceled. Accordingly, claims 2, 3, 6-13, and 20-23 are pending, of which claims 2, 3, 6, 8, 20 and 21 are independent.

Referring now to the Office Action, claim 20 is objected to as the language is not consistent throughout the claim. Applicant has amended claim 20, as shown above to correct the informality.

Claims 2, 3, 9, 10 and 21 have been rejected under 35 U.S.C. § 112, second paragraph, as failing to particularly point out and distinctly claim the subject matter which the Applicant regards as his invention. In particular, claims 2, 3, 9, 10, and 21 lack antecedent basis for various claimed features cited by the Examiner. Applicant has amended claims 2, 3, 9, 10, and 21, as shown above, to provide proper antecedent basis for all claimed features.

In view of the amendments to correct the informalities and the lack of proper antecedent basis, the objection and § 112, second paragraph, rejections are respectfully requested to be reconsidered and withdrawn.

Claims 1, 2, 3, 6-13, and 20-23 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Zhang et al. (U.S. Patent No. 5,830,784) in view of Zhang et al. (U.S. Patent No. 5,569,610) and Otani et al. (JP 9312260A). These rejection are respectfully traversed.

The primary feature of the claimed invention resides in the use of a catalyst such as nickel for promoting crystallization of a semiconductor film and the use of a laser beam having a rectangular or square irradiation surface and having a large irradiation area of 10 cm² or more in order to perform the crystallization of a semiconductor film more efficiently. Furthermore, the claimed invention resides in a pulse width of 200 nsec or longer, which is advantageous to optimize a period for crystallization.

It is well-established that, in order to show obviousness, all limitations in the claim must be taught or suggested by the prior art. In Re Boyka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974); MPEP § 2143.03. It is error to ignore specific limitations distinguishing over the references. In Re Boe, 184 U.S.P.Q. 38, 505 F.2d 1297 (C.C.P.A. 1974); In Re Saether, 181 U.S.P.Q. 36, 492 F.2d 849 (C.C.P.A. 1974); In Re Glass, 176 U.S.P.Q. 489, 472 F.2d 1388 (C.C.P.A. 1973).

Applicant respectfully submits that the Office Action failed to address all limitations in the rejection of claims 1, 2, 3, 6-13, and 20-23. In particular, with respect to amended claims 2 and 3 the Office Action did not address the claimed features of, e.g., a third step of irradiating a laser beam shaped in a rectangle or a square while moving the laser beam from one side of the semiconductor film toward another side thereof to sequentially crystallize the semiconductor film to form a crystalline semiconductor film, wherein the laser beam has an irradiation area of the pulsed laser beam of 10 cm² or more.

With respect to claims 6 and 8, the Office did not address the claimed features of, e.g., a third step of irradiating a laser beam whose irradiation area in one shot is 10 cm² or more to the semiconductor film to crystallize the semiconductor film and to form a crystalline semiconductor film.

With respect to amended independent claim 20, the Office did not address the claimed features of, e.g., crystallizing the semiconductor film by irradiating the semiconductor film with a pulsed laser beam, wherein the laser beam has a pulse width of 200 nsec or more, and wherein the laser beam has an irradiation area of the pulsed laser beam of 10 cm² or more.

With respect to amended independent claim 21, the Office did not address the claimed features of, e.g., crystallizing the semiconductor film by irradiating the semiconductor film with a pulsed laser beam having a square shape cross section, wherein the laser beam has a pulse width of 200 nsec or more and an irradiation area of the pulsed laser beam is 10 cm² or more.

All cited prior art references of Zhang et al. ('610 and '784) and Ohtani are deficient in disclosing or suggesting the above-discussed features, as the Office failed to consider these features. Therefore, the cited prior art references, applied separately or combined, do not cure each other's deficiencies. Accordingly, the §103(a) rejections of independent claims 2, 3, 6, 8, 20, and 21 and dependent claims 9-13, 22, and 23 are insupportable and requested to be reconsidered and withdrawn.

Claim 1 has been canceled. Therefore, the rejection of claim 1 is now moot.

Further to Applicant's arguments set forth above, Applicant also respectfully notes that the burden of establishing a prima facie case of obviousness under §103 lies with the Patent Office. In re Fine, 5 USPQ2d 1596 (Fed. Cir. 1988). To establish a prima facie case of obviousness, there must be (1) some suggestion or motivation (either in the references themselves or in the knowledge generally available to one of ordinary skill in the art) to modify the reference or to combine reference teachings to achieve the claimed invention and (2) the prior art must teach or suggest all the claim limitations (MPEP § 2143), as mentioned above. The Office Action failed to particularly point out the language in the cited prior art references that suggests or motivates one to modify the reference or to combine the references' teaching to make Applicant's claimed invention recited in independent claims 2, 3, 6, 8, 20, and 21 and dependent claims 9-13, 22, and 23. Thus, a prima facie case of obviousness has not been established.


CONCLUSION

Having responded to all rejections set forth in the outstanding non-Final Office Action, it is submitted that claims 2, 3, 6-13, and 20-23 are now in condition for allowance. An early and favorable Notice of Allowance is respectfully solicited. In the event that the Examiner is of the opinion that a brief telephone or personal interview will facilitate allowance of one or more of the above claims, the Examiner is courteously requested to contact Applicants' undersigned representative.

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VERSION OF AMENDED CLAIMS WITH
MARKINGS TO SHOW CHANGES MADE

2. (Amended) A method of manufacturing a semiconductor device, comprising:
- a first step of forming a semiconductor film;
 - a second step of holding a catalytic element that promote the crystallization of said semiconductor film in contact with said [amorphous silicon] semiconductor film;
 - and
 - a third step of irradiating a laser beam shaped in a rectangle or a square while moving the laser beam from one side of said semiconductor film toward another side thereof to sequentially crystallize said semiconductor film to form a crystalline semiconductor film,
- wherein said laser beam has an irradiation area of said pulsed laser beam of 10 cm² or more.
3. (Amended) A method of manufacturing a semiconductor device, comprising:
- a first step of forming a semiconductor film on a substrate having an insulating surface;
 - a second step of holding a catalytic element that promote the crystallization of said semiconductor film in contact with said semiconductor film; and
 - a third step of irradiating a laser beam shaped in a rectangle or a square from one side of said [amorphous silicon] semiconductor film toward another side thereof while moving said substrate to sequentially crystallize said semiconductor film to form a crystalline semiconductor film,
- wherein said laser beam has an irradiation area of said pulsed laser beam of 10 cm² or more.
9. (Amended). A method of manufacturing a semiconductor device as claimed in claim 1, 2, 3, 4, 5, 6 or 8, wherein [the] a pulse width of the laser beam irradiated in the third step is 600 nsec to 1 msec.

10. (Amended) A method of manufacturing a semiconductor device as claimed in claim 1, 2, 3, 4, 5, 6 or 8, wherein [the] a laser energy density of the laser beam irradiated in the third step is 100 to 800 mJ/cm².

20. (Amended). A method of manufacturing a semiconductor device comprising the steps of:

forming [an amorphous] a semiconductor film comprising amorphous silicon on an insulating surface;

providing said semiconductor film with a crystallization promoting material . comprising a metal;

crystallizing said [amorphous] semiconductor film by irradiating said [amorphous] semiconductor film with a pulsed laser beam,

wherein said laser beam has a pulse width of 200 nsec or more,

wherein said laser beam has an irradiation area of said pulsed laser beam of 10 cm² or more.

21. (Amended) A method of manufacturing a semiconductor device comprising the steps of:

forming a semiconductor film on an insulating surface;

providing said semiconductor film with a crystallization promoting material comprising a metal;

crystallizing said [amorphous] semiconductor film by irradiating said [amorphous] semiconductor film with a pulsed laser beam having a square shape cross section,

wherein said laser beam has a pulse width of 200 nsec or more, and an irradiation area of said pulsed laser beam is 10 cm² or more.